

Unless someone like you cares a whole awful lot, nothing is going to get better. It's Not.
- Dr. Seuss, The Lorax

UNIT I

THE BIG CLIMATE CHANGE EXPERIMENT



Unit I Guiding Question

Does the world's rising temperature affect me?

A NOTE FROM THE HOT AUTHORS

The Hot: One World, One Climate curriculum and simulation is a collaborative effort among secondary teachers, educational experts and journalists with faculty and staff from the NASA Goddard Institute for Space Studies (GISS) and the Columbia University Earth Institute. This interdisciplinary team – known as The GISS Climate Education Advisory Group – has been able to draw on many perspectives and areas of expertise to advance a real world, problem-based approach for student learning around many climate change topics.

The curriculum is designed to reinforce academic knowledge and skills outlined in national education standards with an eye toward student inquiry and research-like experiences. While exploring the science and stories of climate change, our goal is for students to use scientific research to propose climate change solutions and literacy skills to share those solutions with the larger process.

Our development process has been an iterative. The Climate Change in the Classroom (CCIC) Teacher Workshop at NASA GISS/Columbia University on August 5 and 6, 2013 is a continuation of this process as we broaden the Hot collaboration to include the review, critique and recommendations of 30 more educators and scientists participating in the 2013 CCIC.

It is important to note that we are in the active stage of review and development of the Hot curriculum and simulation. Hence, the materials being field-tested at CCIC are not in their final form and require additional educational and scientific review. This is one of the major goals of the CCIC Teacher Workshop.

We hope that the Hot curriculum and simulation will prove to be a meaningful way for you and your students to engage in learning about Earth in the context of an important global issue – climate change. We also hope Hot is personally relevant students, and motivates a lifetime of interest and critical thinking about our planet and the special role humans have in the Earth system.

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UNIT I AT-A-GLANCE

Students engage in lessons where they develop some basic background knowledge about climate change drawing on research from scientists around the world. They will begin to develop key ideas that climate change is happening, we can observe it and it is a global problem. Students also begin to understand some of the lines of climate change evidence. More fundamentally, Unit I explores the relationship between climate and life, helping students explain the difference between weather and climate.

Summative Assessment

Write a short news story using understandings developed in Unit I to describe the roles of humans and carbon in Earth's climate change story. The essay should accurately relate and explain at least one key climate science concept (e.g., difference between weather and climate) as well as 3 or more lines of climate change evidence. It should also express the influence of these roles in terms of time and spatial scale relevant to the climate change story. We may be able to set up a blog page where the best of these articles could be shared on the Real World Matters website.

National Education Standards Addressed

Learning objectives for each lesson relate to national education standards found in the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS). Each lesson identifies the specific standards addressed.

Unit I Learning Progression

Following input received from the 2013 Climate Change in the Classroom Teacher workshop, we will prepare a learning progression for the Unit. In its final form it will provide a short introduction and a lesson grid with brief summaries of student activities, learning objectives, standards addressed and performance assessments.

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ENGAGE

Unit I Pre-Exploration & Assessment

TIME: 90 minutes or 2 class periods + homework



The diagnosis from one of Earth's "climate doctors" ...

Diagnosis: "We think something is wrong. We can detect that the temperature is warming and lots of things are changing...carbon dioxide and other greenhouse gases are warming the planet."

Prognosis: "What we can predict is things are going to get worse."

Treatment: "Think about ways to reduce carbon emissions."

- Gavin Schmidt, NASA Goddard Institute for Space Studies

overview

Students are introduced to the climate change problem through short videos from a noted climate scientist, the news, and cartoons.

objectives

The student will be able to...

- explain their current understandings about climate change
- identify questions about what they would like to learn

prerequisite

None

key vocabulary

Climate change attribution – a method scientists use to identify the various causes of climate change, including "fingerprints" of human-caused climate change.

Climate or weather extreme – reaching a high or highest degree, an event outside the range that we normally experience.

Mitigate – to make less severe or reduce the negative impacts.

differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed Full Articulation TBD

unit's student skill badges to earn

Academic knowledge / Social Emotional / Workforce and Global Citizenship / e.g., MacArthur "Open Badges" Full Articulation TBD

subjects

Earth & Environmental Science, Language Arts, Social Studies

standards

NGES ESS3.D Global Climate Change

Human activities affect global warming

CCSS ELA Literacy

Present information and findings (SL.4)

Determine the central idea from text and media (RI.2)

resources / materials

- Computers with Internet access
- LCD Projector with ability to stream video
- Hot video lecture I "The Big Climate Change Experiment" (5:53 minutes) (<http://goo.gl/Mk3gm>)
- ABC News: "The forecast is looking more and more extreme," (2:05 minutes) <http://youtu.be/atrl6CR6Lus?list=PLEB5BD521B9ED258F>
- Climate Change News and Political Cartoons web site, <http://goo.gl/lpzQo>

Does the world's rising temperature affect me?

background

Earth is getting hotter. Our climate is changing. For decades, scientific research has indicated that increases in the amount of carbon dioxide (CO₂) in our atmosphere, primarily from burning fossil fuels, would cause the planet to warm. Among other damaging impacts, this warming will change rainfall and storm patterns around the world, raise sea level, and disrupt food and water supplies. All over the world, people are now experiencing these and other impacts of human-caused climate change. Higher summer temperatures and more severe droughts in the American Southwest are contributing to dangerous wildfire seasons. Record floods are hitting many places around the world, including South Asia and central and Western Europe. Decades of droughts in East Africa are worsening the food and humanitarian crisis in the region. Loss of mountain glaciers is threatening important sources of freshwater in South America and the Himalayas.

Scientists now have numerous lines of very strong evidence that indicate global climate is changing and human activities are the dominant cause. These lines of evidence are part of a vast body of scientific knowledge that developed over the past 150+ years from systematic measurements, observations and analysis.

Climate change is an important, evolving story. But how does climate change affect each of us? Unit one (and specifically lesson 1.1) is designed to assess what students already know about climate change, build background about the science of climate change and explore how climate change may impact students' lives.

suggested procedure

1. Give students the CLIMATE CHANGE PRE-ASSESSMENT on the student pages (over time we might host this as a Google doc form that we can share with teachers and use to collect data). Remind them that their responses to this assessment are not graded and will be used to see what they learn over the course of the unit. Briefly discuss students' answers in a large group.
2. As a class, watch the Hot video: Lecture 1 The Big Climate Change Experiment. (5:53 minutes) where NASA Goddard Institute for Space Studies climate scientist, Dr. Gavin Schmidt, explains climate change using a medical analogy.
3. Have the students respond to this video in box / "card" #1 on the THREE 4 THINKING student pages. Ask students to share out in pairs or to the whole group.
4. Show the class the ABC News clip, "The forecast is looking more and more extreme." (2:05 minutes).
5. Have the students respond to this video in box / "card" #2 on the THREE 4 THINKING students pages. Ask students to share out in pairs or to the whole group.
6. Working in pairs or as a homework assignment, have students review 5-6 cartoons on the web site, "Climate Change News and Political Cartoons."
7. Have the students respond to cartoons of their choosing in boxes / "cards" #3 & #4 on the THREE 4 THINKING student pages. Ask students to share out in pairs or to the whole group.

wrap-up and discussion

Here is where students can reflect on and write a response to the following questions that they will present to the class: What are some of the themes in the videos and cartoons you reviewed? What seem to be the main factors concerning contributing to the climate change problem? Are there solutions or actions presented? If so, what are some examples? Students can present the responses to these questions in various ways – written statement, create a cartoon of their own, a skit, a short speech, etc.

Pre-assessment

Student response to the discussion prompts for the videos and class presentations.

STUDENT PAGE LESSON 1.1 Pre-Exploration and Assessment

Name: _____

Climate Change Pre-Assessment

Date: _____

Instructions: These four questions are designed to assess your knowledge about climate change **BEFORE** you explore the *Hot* curriculum. Your answers **will not** be graded. However, your responses to the questions will be collected to compare with your answer to the same questions at the end of Unit.

1. How does climate influence human society?

2. What is the difference between weather and climate?

3. How do scientists know climate is changing?

4. What are some important factors causing climate to change?

STUDENT PAGE LESSON 1.1 Pre-Exploration and Assessment

Name: _____

Three 4 Thinking Reflection LEO®

Date: _____

Use the following “notecards” to respond to each of the visual texts in Unit 1.1. Each “card” corresponds to a specific text. Please use one of the four prompts below to guide your responses.

“

Write down a quote or passage from the text that was meaningful to you. Remember, a quote can be anything – it does not just have to be something someone “said.” For example, if we quote from a Wikipedia entry it can be anything taken from that specific entry.



Write down an idea presented in the text that interested or intrigued you.

AH-HA

Write down an “ah-ha” moment you had when you were interacting with the text. An “ah-ha” moment is something you had never thought of before or something that suddenly became clear.



Write down a connection or “link” between the text and something else you’ve learned, read or studied, a personal experience or something you know about from the world.

TEXT: Hot lecture 1 “The Big Climate Change Experiment”

1. Circle your choice of response “ .  . ?


TEXT: ABC News “The Forecast is Looking More and More Extreme”

2. Circle your choice of response **AH-HA** .  . ?

TEXT: Climate Change Cartoon #1 _____

3. Circle your choice of response **AH-HA** .  . ?

TEXT: Climate Change Cartoon #2 _____

4. Circle your choice of response “ .  . ?

TEACHER NOTE: We recommend using these as four “notecards.” If students cut them out at the end of reading/viewing/listening to a text they can share their cards on the floor and sort them by themes and ideas (aka an affinity sort). That way the “Three 4 Thinking” cards become a differentiated tool for a kinesthetic whole-group discussion of the text that allows everyone’s voice to be heard.

This Learning Experience Organizer (LEO) is adapted from Mindblue’s “Three 4 Thinking” LEO ©201

Does the world's rising temperature affect me?

EXPLORE**I.2 The Influence of Climate on Culture****TIME:** 45-60 minutes or 1 class period + homework

"Our climate has influenced where we have built our cities, where we plant our crops, how we travel, what we eat and sometimes, how we die."

- Climate Change: Picturing the Science

overview

Students explore and compare some of the ways climate influences life and culture in different regions through global stories and images.

objectives

The student will be able to...

- identify 3-5 climate characteristics of climate in a specific region
- compare and contrast the influence of climate on culture in two regions
- illustrate the effects of local/regional climate on a culture through a short comic or essay

prerequisite

None

key vocabulary

Adaptation: The action of changing based on changing circumstances.

Climate: The average weather patterns common to an area or region over an extended period of time.

Culture: The learned behavior of a society or a subgroup (as defined by Margaret Mead).

Diversity: To be composed of different types of things – people, plans, customs, beliefs animals etc.

Environmental: Relating to the human impact on the natural world

Fossil Fuel: A fuel like coal, oil or gas formed from the carbon-base remains of past life.

Livelihood: What someone does to secure essential things (food, water, shelter, clothing etc.) – usually used in reference to a kind of work.

Terrestrial: Defining characteristics of the land like mountains, plants, wetlands, etc.

differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed...

subjects

Earth & Environmental Science,
Language Arts, Social Studies

standards**NGES ESS3.A Natural Resources**

Resource availability has guided the development of human society

CCSS ELA Literacy

Critically read informational text and use diverse media (RI.1-3, 7)

Write to support claims and examine a topic (W.1-2)

resources / materials

Computers with Internet access

LCD Projector with ability to stream video

World Map see "National Geographic's Map Maker resource" for teachers at

<http://goo.gl/xbiyN>

World Wildlife Foundation online videos, "Stories of Climate Change and Climate Action" <http://goo.gl/55CRO>

Copies of attached CULTURE & CLIMATE ANALYST Learning Experience Organizer (LEO).

background

Throughout human history, climate has played a major role in shaping life and culture on our planet. Climate is described by several factors that make up the usual conditions found in a place throughout the year - how wet, dry, cold, hot, windy, humid, and the composition, density, and pressure of the air. These factors are closely related to the features of the physical landscape in an area and its location on Earth.

Climate also produces the amazing environmental diversity found around Earth. These include: tropical rainforests in Brazil, arctic regions in Russia, arid deserts in Egypt and temperate mid-Atlantic cities in the U.S. Distinct cultures emerged from these climate conditions. So, the climate people experience varies depending on where we live and influences how people live, what they do for a living, their development and even their level of prosperity.

In large part, this is because climate determines the variability and availability of natural resources people depend on like food, water and energy, as well as the weather. Just think about the United States. The Atlantic hurricane season affects people on the East coast, but mostly southern states. In Alaska ice fishing is a staple of life. Warm, sunny and humid conditions in Iowa are ideal for producing their famous corn. Vacationers and retirees seeking year-round warmth often head to Arizona. There is a certain comfort in knowing what weather to expect in the region - when to expect it, for how long (duration), over what period (frequency) and what characteristics it should have (intensity, amount, level).

Throughout human history, climate has played a major role in life and culture. Now that there are 7 billion people living on our increasingly crowded planet, the impact of humanity is so large that today people are able to influence global climate. Our massive presence on the planet leaves us at a unique moment in time when our actions have a larger impact on the climate than nature.

Here are three big questions to think about: How does climate affect us? How does our culture affect the climate? How might we change our culture to reduce our impact on climate?

suggested procedure

1. Ask students what comes to mind when you think of the influence of climate on culture. They can use words, phrases, and/or images and explain the sources for this knowledge.
2. Screen the video "Climate Witness-Marlene Rocha, Brazil" (3:39 minutes) - <http://goo.gl/5Mo04> - or read the text of Marlene's story to the class.
3. Ask students to identify and describe characteristics of climate and culture where Marlene lives in Brazil. *Suggested prompts:* Where is the Brazilian Amazon located on the world map? What are some of the usual weather conditions throughout the year? What are some other physical features of the region? What are aspects of life and culture for people who live in Marlene's region? How do people adapt to the climate? Exchange ideas about connections between climate and culture. Model answering these questions on the "Culture & Climate Analyst" Learning Experience Organizer (LEO) for this lesson.
4. Working individually or in pairs, students may select one of the three following regional climate witness stories and their associated scientific review. The stories can either be printed out or read on the Internet. Students record their observations about the region using the "Culture & Climate Analyst" Learning Experience Organizer (LEO). This LEO allows students to describe and analyze how changing climate conditions and cultural characteristics might impact regional cultures. Students are also encouraged to do an Internet search for additional information on the region to enhance their observations.

Gung Qui Lai Jai, China - <http://goo.gl/IE0b0>

Nola Royce, New York - <http://goo.gl/8JrqB>

Jerome Robles, Malaysia - <http://goo.gl/VRcmm>

EXTENSION: For teachers interested in an extended analysis of Culture & Climate consider using the "Culture & Climate Analyst" Learning Experience Organizer (LEO) while students listen to *This American Life* Episode #495 – "Hot in My Backyard" – Act I: The CO₂ in CO (18 minutes) at <http://goo.gl/w9zqX>.

wrap-up and discussion

Students who read each of the climate stories form small groups for a Pair/Share activity to compare and contrast the different global region's culture and climate connections.

.....

assessment

Each student prepares a 300-500-word essay or a 6-panel comic strip describing ways climate influences global life and reflecting on the introductory quote to the lesson. The essay or comic should accurately use at least 3 of the words from the vocabulary list and provide examples from at least 1 of the Climate Witness Stories as support. Students may use any of the following online comic generator tools to support their work: Comic Life, Kerpoof, Comicssketch, Comics Lab/Extreme, PikiStrips, Toondoo, Bubblr, Comiqs, My Comic Book Creator, BitStrips, ReadWriteThink's Comic Creator, Make Beliefs Comix, Myths & Legends Story Creator, Cartoonist, Pixton, Chogger.

.....

feedback

The authors of Hot value your thoughts and feedback on this curriculum. Please feel free to send us any suggestions or share anything your students found particularly interesting or engaging.

Comments can be sent to cah40@columbia.edu

STUDENT PAGE: LESSON 1.2 THE INFLUENCE OF CLIMATE ON CULTURE

CLIMATE & CULTURE ANALYST

Name: _____

Date: _____



MARGARET MEAD
Cultural Anthropologist,
Writer – USA 1901-1978

The **CLIMATE & CULTURE ANALYST'S** job is to focus on the effect of climate on the culture of an area of the world. Climate variables include weather patterns like temperature, precipitation and wind as well as physical (aka terrestrial) features like mountains, lakes, and vegetation that are linked with the regions' climate. Use this Learning Experience Organizer (LEO) to reflect on the impact of cultural characteristics – like work, home, education, food, water, sports, power supplies, and education, on climate. If you are interested in learning more about your region, do utilize the internet for additional information.

Please be prepared to share your ideas and hypotheses with your group.

PLEASE MAKE A DOT ON THE LOCATION OF YOUR CLIMATE STORY:



© 2009 www.outline-world-map.com

CLIMATE VARIABLE	"NORMAL" CLIMATE CONDITION	NOTICIBLE CHANGE (Δ) IN CLIMATE CONDITION	THE Δ 'S IMPACT ON CULTURE
<input type="checkbox"/> TEMPERATURE <input type="checkbox"/> WIND <input type="checkbox"/> AQUATIC <input type="checkbox"/> TERRESTRIAL <input type="checkbox"/> OTHER			
<input type="checkbox"/> TEMPERATURE <input type="checkbox"/> WIND <input type="checkbox"/> AQUATIC <input type="checkbox"/> TERRESTRIAL <input type="checkbox"/> OTHER			
<input type="checkbox"/> TEMPERATURE <input type="checkbox"/> WIND <input type="checkbox"/> AQUATIC <input type="checkbox"/> TERRESTRIAL <input type="checkbox"/> OTHER			

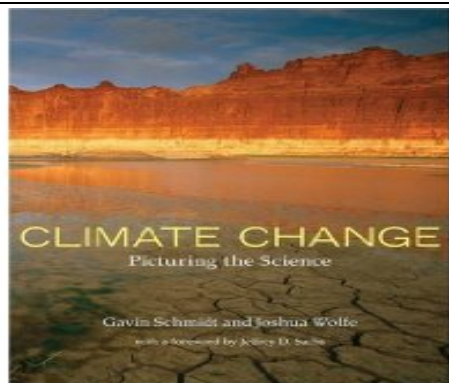
"Our humanity rests upon a series of learned behaviors, woven together into patterns that are infinitely fragile and never directly inherited." – **Margaret Mead**

This Media Circle Learning Experience Organizer (LEO) for Differentiated Literacy is adapted from Goble & Goble's forthcoming book of the same name ©2013

OBSERVE AND ANALYZE

I.3 CLIMATE CHANGE: LINES OF EVIDENCE

TIME: 90 minutes or 2 class periods + homework



"A doctor can examine our symptoms, try to diagnose our condition, and suggest treatments if the prognosis is not favorable. The success of modern science shows clearly that, even when medical knowledge is not perfect, it is useful. This is also true for climate scientists studying the Earth – the science is imperfect – but still useful."

- Climate Change: Picturing the Science

overview

Students observe and analyze images and graphs scientists use to explain climate change. They also make initial inferences about relationships between energy use, CO₂ emissions and global temperature.

objectives

The student will be able to...

- identify 3-5 lines of climate change evidence related to land, ocean and/or the atmosphere
- interpret graphical data to describe climate change lines of evidence qualitatively and quantitatively
- make inferences from the results of climate change research to construct an evidence-based narrative about the underlying science for a general audience

Prerequisite

None

key vocabulary

Anomaly: Something that deviates from the normal, standard or expected.

Diagnosis: Identifying the nature or cause of a condition or problem.

Inference: To shift from analyzing data to making a generalization or formulating an opinion based on facts or evidence.

Infrastructure: Basic structures and facilities (roads, buildings, etc.) in an area.

Prognosis: The prospect, chance or outlook for recovery from the condition/problem.

Policy-maker: Someone who sets plans for government and/or business.

Qualitative Data: describe the quality of something like size, appearance, change, etc., using adjectives as opposed to numbers.

Quantitative Data: describe something as a measured quantity.

Symptom: Evidence that indicates the existence of condition or problem.

Unabated: Without any reduction in strength, force, or intensity.

subjects

English Language Arts, Earth and Environmental Science, Social Studies and Mathematics

standards

NGES ESS3.D Global Climate Change

Human activities affect climate

CCSS Math Literacy

Describe relationships between quantities in a graph (F.B.5)

CCSS ELA-Literacy:

Analyze author ideas and claims from text (RI.5)

Engage in collaborative discussions and claims and findings (SL.1-3, 4)

resources / materials

Chasing Ice film clip (4:41 minutes) at <http://youtu.be/hC3VTglPoGU>

Synopsis of *Chasing Ice* film at <http://goo.gl/TOizX>

Cut up copies of CLIMATE CHANGE IN THE NEWS DATA SHEETS I-II

Copies of Climate Math, answers are on the following teacher page

differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed....

background

Climate change is becoming a ubiquitous topic in today's news headlines. Extreme weather events related like Hurricane Katrina's devastation of New Orleans in 2005 or the 2012 wildfire season that destroyed millions of acres of land and infrastructure across the American west are increasingly connected to climate change and our national narrative.

Scientists are often asked to comment on these and other climate change related stories to provide expert opinion. When scientists comment on these events, they utilize various lines of evidence to help explain the extreme weather we are increasingly experiencing. For this reason some graphical representations of this evidence are used so frequently they are becoming recognizable, even "popular" to the general public.

The purpose of these lines of visual evidence is to help the public and policymakers understand research-based evidence about how climate is changing, why it is changing, and what climate change and impacts we might expect in the future (predictions). For that reason, to gain a deeper understanding of climate change story, one must have science and media literacy skills.

In this lesson students begin thinking about the numerous lines of evidence scientists have found as a result of decades of climate measurements and research that indicate human emissions of greenhouse gases like CO₂ are the major cause of increasing global temperature. By observing and analyzing various climate data presented in graphs and images, students practice interpreting science data that comes to us in various forms. Exploring this data allows students to begin to develop understandings of the climate change story.

suggested procedure

K-W-L Chart

1. Read the quote at the beginning of the lesson out loud to the class. Ask students to elaborate on how the medical analogy relates to climate change.
2. Have students complete the first two columns of the K-W-L Table on the student pages to organize their current thinking about - "What do they know" and "What they want to know about climate change." Teachers can choose whether they want to have students share some of their responses and organize them around broad topics and questions.
3. Tell students they are going to "think like climate scientists" preparing to present their research to the public. Before they do this, teachers may want to have a short discussion with students about methods scientists use to analyze data. The discussion should highlight that scientists make observations (measurements of the real world) to answer scientific questions. These measurements are transformed in various ways for analysis – graphs, images, formulas, statistics, data tables, etc. Also, scientific analysis involves looking at one or more variables over some time and spatial scale. Teachers might also want to ask students what skills are needed for scientific analysis – possible responses might include: patience, creativity, technical, open-mindedness, objectivity, perseverance, etc. Teachers can also get more specific by asking students – what quantitative skills do scientists need to analyze data and what qualitative skills do scientists need?

observe

4. To give students guided practice in making observations and analyzing climate data (qualitatively), show the class film clips from the movie *Chasing Ice*. Stop the film at 3:30 minutes. The film can be introduced by telling students that environmental photographer, James Balog, traveled to the Arctic on assignment for National Geographic. The assignment turned into a multi-year project – "An Extreme Ice Survey" – to record what is happening to Earth's glaciers. Before you play the clip a second time distribute the student page *CHASING ICE OBSERVATION GUIDE*. As students watch the film they record their observations on the sheet.

Alternate idea: prior to watching the film, teachers can divide students into four groups, each responsible for reviewing the climate information presented in the film with a certain temporal or spatial scale perspective – global, regional, short-term or long-term.

5. Give students a few moments to complete recording their observations and identify 3-5 questions they have about what they observe and would want to know to quantify these observations.

6. Play the remainder of the film clip. Discuss student observations and questions. Ask students whether the film's documentation of retreating glaciers should be considered a line of evidence for climate change and why or why not.

analyze lines of evidence

7. Cut up the attached student pages DATA SHEETS so that each student can have two pieces of data to explore individually. Give them the student page REFLECTING ON LINES OF EVIDENCE. Individually students should imagine they are a group of climate scientists preparing to present research to a journalist developing a story about climate change. The images and graphs are provided on the student page CLIMATE RESEARCH IN THE NEWS and the questions to answer are the student page CLIMATE CHANGE EVIDENCE REFLECTION. Students answer such questions such as: What is being measured? What is the time or spatial scale? What does the graph or image show?
8. Divide the students into small groups – first in groups that have the same graphs and then groups with a wide variety of graphs. Have students share their findings from their individual images and graphs used by scientists to explain evidence of climate change to the public and the media.
9. Tell the students that they are going to be responsible for analyzing the data to answer various questions. It will be important to look for what is being measured, the scale (time and space) covered by the data and what the data tell us.

wrap-up and discussion .

10. As a group students should reflect on the question at the bottom of the CLIMATE CHANGE EVIDENCE REFLECTION SHEET.

EXTENSIONS: Students can draw on the lines of climate change evidence they studied as well as Internet research about the climate change debate to consider possible reasons why some Americans do not recognize the scientific agreement that humans are the main drivers of present-day climate change and potential consequences of unabated climate change.

Climate Math: Students solve math problems on the Climate Math student pages. Answers are on Teacher Page that follows.

assessment

Making Inferences about Climate Change (responses to reflection and graphic organizer)

feedback

The authors of Hot value your thoughts and feedback on this curriculum. Please feel free to send us any suggestions or share anything your students found particularly interesting or engaging.

Comments can be sent to cah40@columbia.edu

STUDENT PAGES: LESSON 1.3 LINES OF EVIDENCE

K-W-L CHART

Name: _____

Date: _____

What do I know ...

About evidence supporting climate change

What do I want to know ...

About evidence supporting climate change

What have I learned ...

About evidence supporting climate change

<p>STUDENT PAGES: LESSON 1.3 LINES OF EVIDENCE</p> <p>CHASING ICE OBSERVATION GUIDE</p>	<p>Name: _____</p> <p>Date: _____</p>
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DIRECTIONS

After viewing the *Chasing Ice* clip, use the spaces below to think about what you observed and how scientists might develop this as a line of evidence.

<p>My observations Qualitative e.g. things I observed but did not measure.</p>	<p>My inferences about causes and effects What might have caused the things they are observing?</p>
<p>My questions to quantify observations How might we find ways to quantify (aka measure) my observations?</p>	<p>What this will tell us? How might the quantitative data work with the qualitative data?</p>

Suggestion: you might consider the scale of the effects (global, regional, short term, long-term)

Film Review Questions

Consider the following quote below from James Balog and write a short reflection about how it relates to the observations you made watching the excerpt from his film *Chasing Ice*.

“I had this idea, the most powerful issue of our time was the interactions of humans and nature.”

STUDENT PAGE: LESSON 1.3 LINES OF EVIDENCE

CLIMATE RESEARCH IN THE NEWS

Name: _____

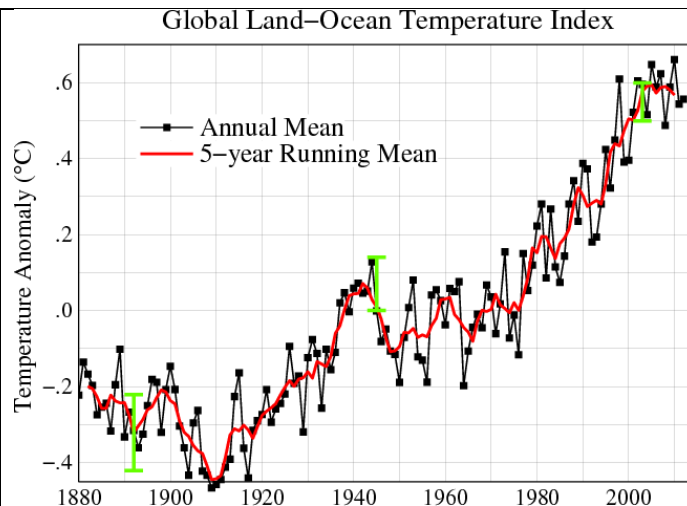
Date: _____

Data Sheet One

Global Surface Temperature Analysis

Line plot of global mean land-ocean temperature index, 1880 to present, with the base period 1951-1980. The dotted black line is the annual mean and the solid red line is the five-year mean. The green bars show uncertainty estimates.

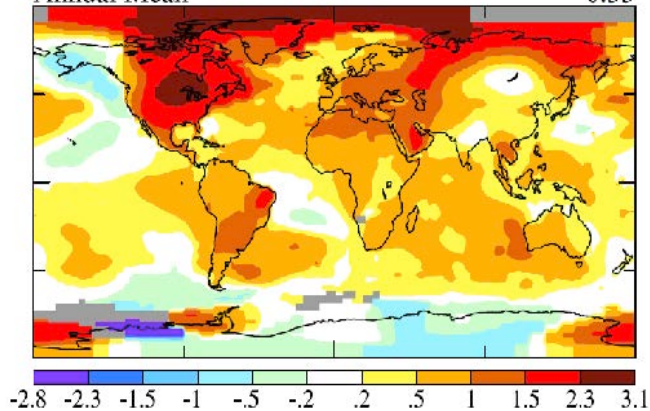
Source: NASA Goddard Institute for Space Studies,
<http://goo.gl/rKtsg>



2012 Surface Temperature Anomaly (°C)

Annual Mean

0.55



Data Sheet Two

Global Surface Temperature Map

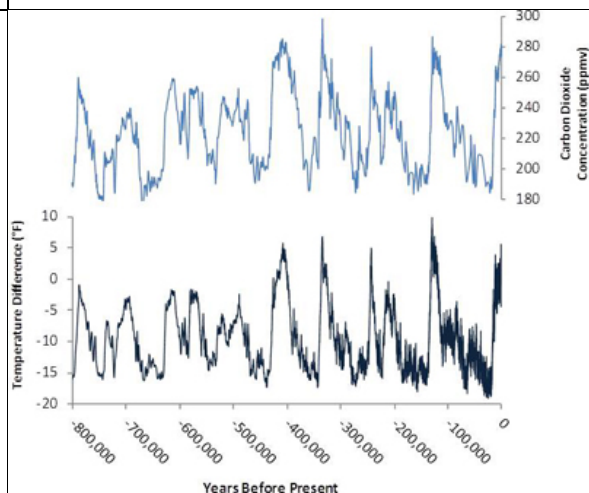
The average temperature in 2012 was about 58.3 degrees Fahrenheit (14.6 Celsius), which is 1.0 F (0.6 C) warmer than the mid-20th century baseline (1950). The average global temperature has risen about 1.4 degrees F (0.8 C) since 1880, according to the new analysis.

Source: NASA Goddard Institute for Space Studies, from NASA/NOAA press materials, <http://goo.gl/ytq4W>

Data Sheet Three

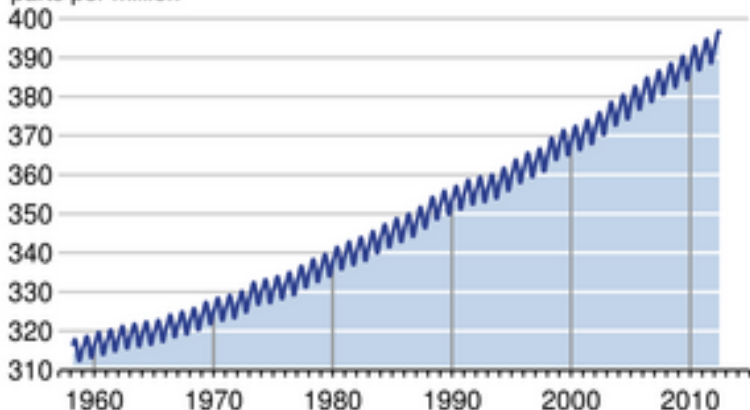
Global Atmospheric CO₂

The graphs show estimates of Earth's carbon dioxide (CO₂) concentrations (top) and Antarctic temperature (bottom), based on analysis of ice core data dating back 800,000 years.
Source: U.S. Environmental Protection Agency, <http://goo.gl/ZMpqb>.



Monthly Carbon Dioxide Concentration

parts per million



Data Sheet Four Monthly Carbon Dioxide Concentration

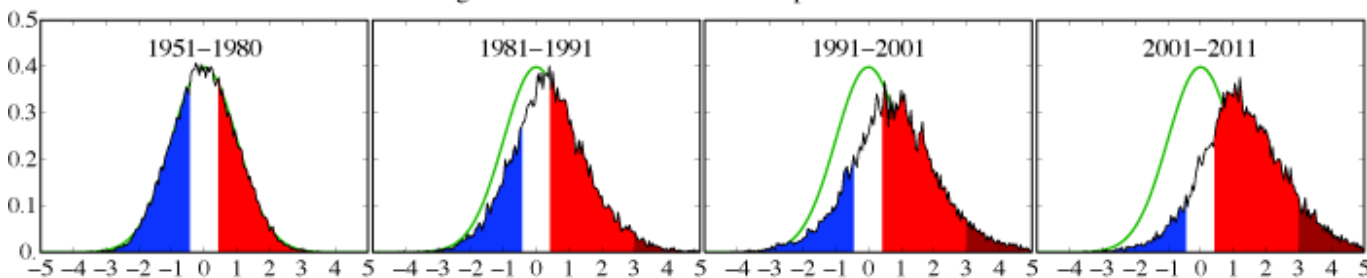
Average atmospheric carbon dioxide concentration versus time at Mauna Loa Observatory, Hawaii (20°N, 156°W) where CO₂ concentration is in parts per million in the mole fraction (p.p.m.).

Source: Scripps Institution of Oceanography,
<http://scrippsco2.ucsd.edu>

Data Sheet Five Likelihood of Warmer Summers

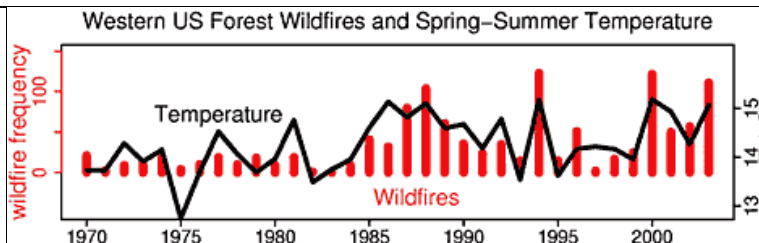
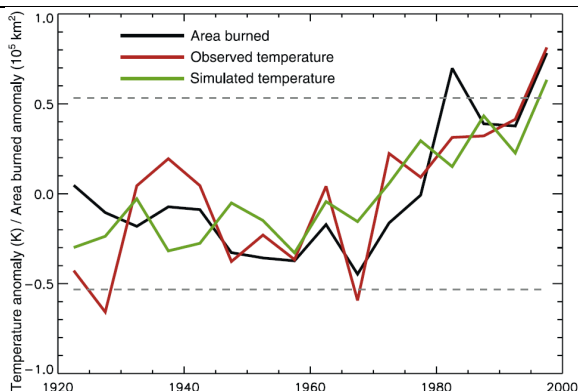
These graphs show changes in the mass of glaciers and ice caps in various world regions and the consequences of sea level rise. Graph (a) shows the changes of glacier mass per square meter for major mountain ranges in the listed regions. Graph (b) shows the total contribution of these changes in glacier mass to global average sea level rise. Source: NASA Goddard Institute for Space Studies, <http://goo.gl/k2rl9>.

Shifting Distribution of Summer Temperature Anomalies



Data Sheet Six Wildfire Trends

Multi-decadal trends in North American wildfires. **Top left:** Area burned annually in Canadian forest fires, 1920-1999 (black line; Gillett et al., *GRL*, 2004). **Top right:** Wildfire frequency (# fires) in the western US vs. spring/summer temperatures (Westerling et al., *Science*, 2006). Both graphs show strong correlations with temperature and changes in area and frequency.



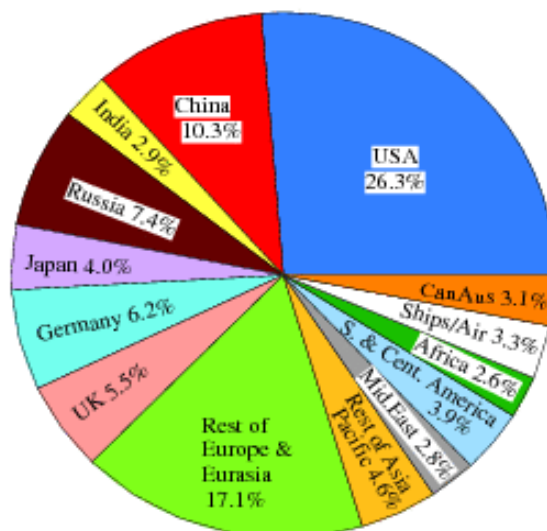
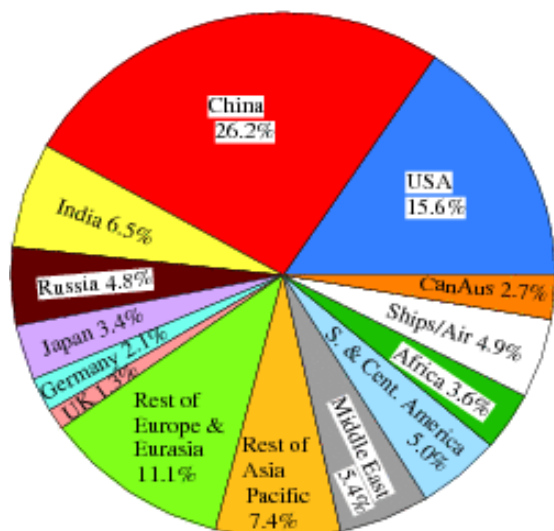
Data Sheet Seven

CO₂ Emissions from Fossil Fuels

(a) CO₂ emissions from global fossil fuel burning (and cement making and natural gas flaring) in 2011 shown by country/region. (b) Cumulative fossil fuel CO₂ emissions over the industrial era (1751-2011). The latter proportions are more important because CO₂ buildup in the atmosphere, and the resulting climate change, is a cumulative process. Source: [Dr. Makiko Sato's web page](#) and based on [CDIAC data](#).

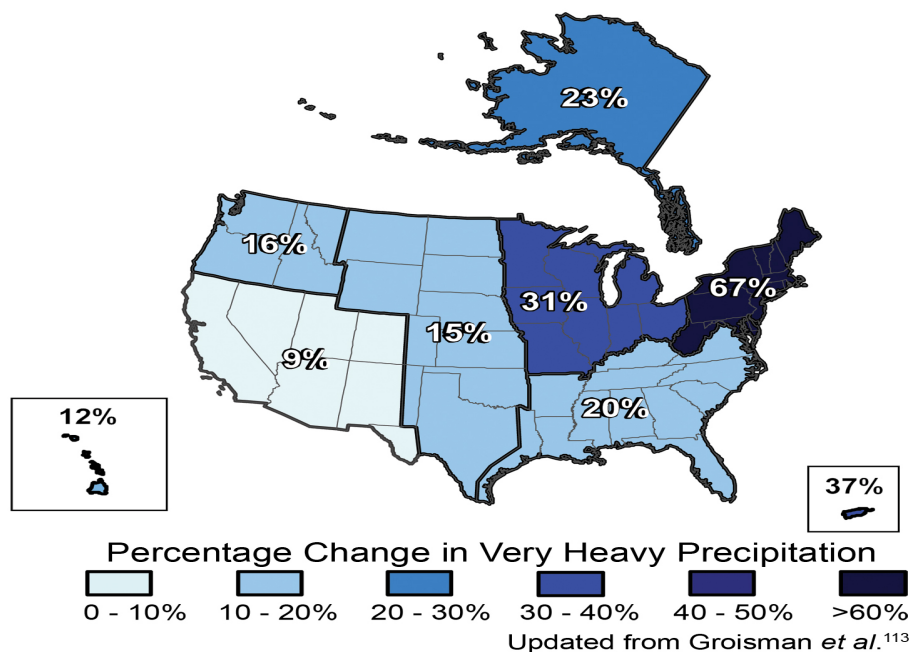
(a) 2011 Annual Emissions (9.5 GtC/yr)

(b) 1751–2011 Cumulative Emis. (374 GtC)



Data Sheet Eight

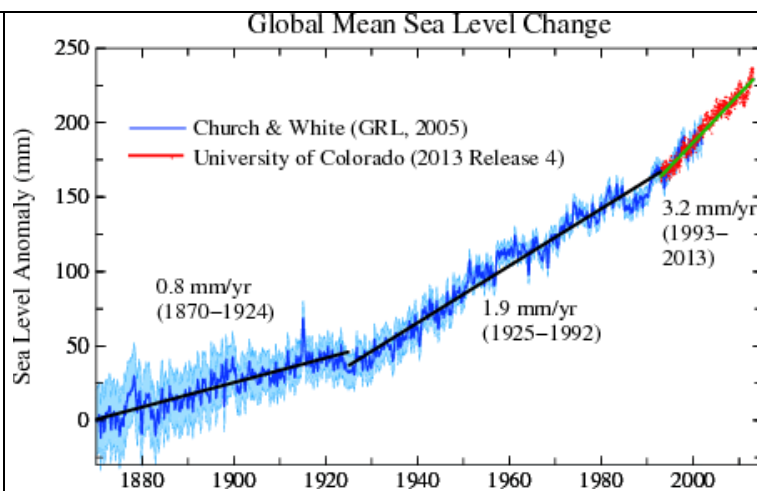
U.S. Extreme Precipitation Events



The map shows the percentage increases in very heavy precipitation (defined as the heaviest 1 percent of all events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Data Sheet Nine Global Sea Level Rise

Global average sea level measured by tide gauges and satellites from 1870 to early 2013. **Source:** Dr. Makiko Sato's web site and satellite data from University of Colorado, <http://goo.gl/INPwVW>



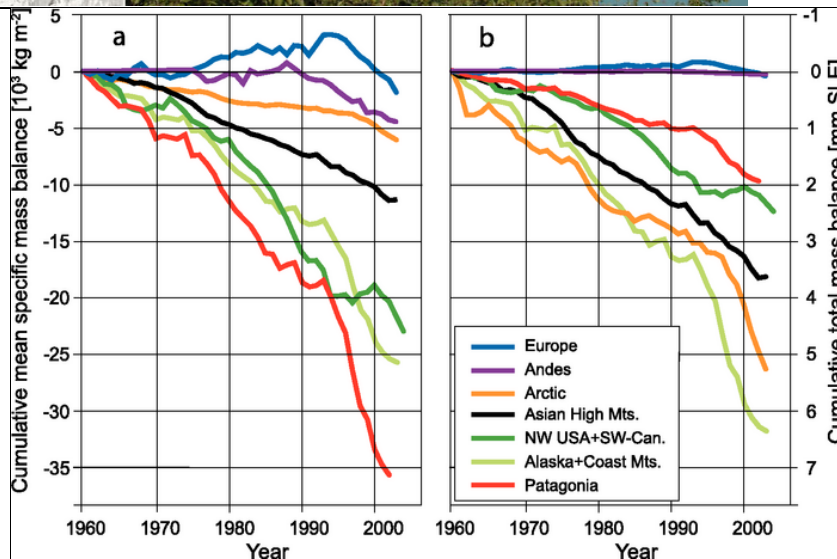
Data Sheet 10 Muir Glacier and Inlet, Alaska

According to the U.S. Geological Survey (see: <http://goo.gl/FN2ss>), in 1850 there were an estimated 150 glaciers in Glacier National Park (left photo) and in 2010 only about 25 remain larger than 25 acres (right photo). **Source:** This is Climate Change, <http://goo.gl/IKBZY>.



Data Sheet 11 Global Change in Glaciers and Ice

The graphs show changes in glaciers and ice caps around the world. Graph (a) shows the change in glacier mass in regions. Graph (b) shows the contribution of regional changes in glacier mass to sea level rise. **Source:** IPCC, <http://goo.gl/qGt9S>



STUDENT PAGE: LESSON 1.3 LINES OF EVIDENCE

Name: _____

CLIMATE CHANGE EVIDENCE REFLECTION

Date: _____

DIRECTIONS

After looking at one or two lines of evidence, please respond to **four of the seven** prompts below.

1. What is being observed or measured and over what time period (timescale)?
2. What is the area covered by the observations (spatial scale)?
3. What does the graph show or what's happening? Is there a trend?
4. What are some interesting patterns in the graph? What might be causing these patterns?
5. What relationships (if any) do you find between the two variables being measured?
6. What questions would you ask climate scientists about the map in an interview?
7. What are the implications of this graph as it relates to people, communities, and the general environment?

DATA SHEET # THAT I EXPLORED: _____

?#

?#

?#

?#

DATA SHEET # THAT I EXPLORED: _____

?#

?#

?#

?#

Reflection

Please share your thoughts on how the passage below relates to your observations and inferences about climate change on the back of this paper.

“A doctor can examine our symptoms, try to diagnose our condition, and suggest treatments if the prognosis is not favorable. The success of modern science shows clearly that, even when medical knowledge is not perfect, it is useful. This is also true for climate scientists studying the Earth – the science is imperfect – but still useful. “Climate Change: Picturing the Science”, p. 3

STUDENT PAGE: LESSON 1.3 LINES OF EVIDENCE

CLIMATE MATH

Name: _____

Date: _____

DIRECTIONS

Review Climate Change in the News Data Sheet 11

Level 1:

Given that the global ocean covers 360 million km² of the Earth's surface and the density of water is 1 g/cm³, calculate the mass of water that's equivalent to 1 mm of global average sea level rise.

Explain how you solve the problem:

Level 2:

Given that the density of ice is 0.9 g/cm³, show that 400 km³ of ice volume loss is equivalent to 1 mm of sea level rise.

Explain how you solve the problem:

Level 3:

Current estimates show that worldwide, there is enough ice (that if it were to melt) to raise sea levels by 70 m. What volume of ice does this represent?

Explain how you solve the problem:

Lesson 1.3

Climate Math - TEACHER PAGE

Answers to Climate Math Problems

Level 1 Problem

Given that the global ocean covers 360 million km² of the Earth's surface and the density of water is 1 g/cm³, calculate the mass of water that's equivalent to 1 mm of global average sea level rise.

1 mm of water over 360 million km² of Earth's surface means 360 km³ of water (because 1 mm = 10⁻⁶ km). Note: there are 10¹⁵ cm³ in 1 km³. Then multiplying by the given density of water yields 360 × 10¹⁵ g = 360 Gt.

Level 2 Problem

Given that the density of ice is 0.9 g/cm³, show that 400 km³ of ice volume loss is equivalent to 1 mm of sea level rise.

ANSWER: To find the volume of ice is equivalent to this much mass of liquid water, we need to divide 360 Pg water by the given density of ice (0.9 g/cm³) which yields 400 × 10¹⁵ cm³ = 400 km³ (after converting the units).

Level 3 Problem

Current estimates show that worldwide, there is enough ice (that if it were to melt) to raise sea levels by 70 m. What volume of ice does this represent?

From the above we know that 400 km³ ice volume = 1 mm of sea level rise. Since there are 1000 mm in 1 m, multiplying both sides by 100 yields 400,00 km³ of ice volume = 1 m sea level. So 70 m sea level rise = 70 × 400,000 = 28 million km³ of ice

MODEL AND EXPLAIN

I.4 Weather Versus Climate

TIME: 90 minutes or 2 class periods + homework



"If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events."

- Climate Change: Picturing the Science

overview

Students explore the difference between weather and climate, using analogies and considering the implications for understanding climate change.

objectives

The student will be able to...

- explain weather and climate and the importance in our lives
- create an analogy to help the public differentiate between weather and climate
- identify ways people confuse climate and weather and the consequences

prerequisite

None

key vocabulary

Statistics: Mathematical practices of analyzing and interpreting large amounts of numerical data that help us describe relationships, find significance, and make predictions.

Frequency: The rate at which something occurs or number of times it is repeated over a period.

Range: The difference between the least and greatest values of a variable.

Consequence: Something produced by a cause or a set of conditions.

Risk: The chance or probability of a loss, injury or negative impact

Topography: The natural or man-made configuration of the land surface.

Air Pressure: The force per unit area exerted on a surface by the air above.

Timescale: A span of time during which events occur.

Extremes: The lowest or highest degree of something, e.g., weather events at the extremes of the historical distribution (unusual, severe).

Analogy: A comparison between similar features of two different things, e.g., heart and a pump.

differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed....

subjects

English Language Arts, Earth and Environmental Science, Social Studies / Geography

standards

NGES ESS2.D Climate and Weather

Climate describes patterns of typical weather over long timescales

CCSS ELA Literacy:

Critically read informational text and use diverse media (RI.1-3, 7)

Engage in collaborative discussions and claims and findings (SL.1-3, 4)

CCSS Math Literacy:

Model situation with linear and exponential functions (F.LE.1)

Represent data on 2 quantities (ID.1)

resources / materials

Blackboard/chalk or butcher block paper/markers

Poster paper

LCD Projector that streams video

Graffiti Boards teaching strategy at <http://goo.gl/xEUBi>

Computers with Internet access

Climate vs. Weather Video (2:00 minutes) <http://on.fb.me/10BFff0>

"Climate in a Nutshell: What is Climate?" video (2:31 minutes) <http://goo.gl/eeHm2>

"Science Made Simple: Take the Dog for a Walk" video: (1:05 minutes) <http://goo.gl/EjU7S>

"Scientists Must End the Climate Confusion" BBC article at <http://bbc.in/16lfbBq>

background

Weather is one of the most common human-interest stories and topics of daily discussion. American author, Mark Twain, said “climate is what we expect, weather is what we get.” These expectations describe a geographic area’s seasonal ranges in temperature, precipitation, winds, air pressure and humidity. Weather is how conditions are day-to-day or on short timescales. Climate is the average of conditions, usually over a 30-year period or longer. These long-term conditions are the result of multiple interactions between the atmosphere, living organisms, bodies of water and the land (topography) that produce regional and global climate.

Distinguishing between weather and climate is a matter of statistics. Scientists studying climate change analyze long data records to answer many questions. Among these questions: Are extreme weather events happening often enough that they are becoming the new normal for climate in a particular region?

Recently, the public is taking notice of extreme weather happening around the world – heat waves, droughts, wildfires, floods and storms – and the devastating impacts. For example, in 2003 summer heat waves in Europe led to over 50,000 deaths. In 2012, hurricane Sandy devastated coastal communities in New York and New Jersey. While one extreme weather event is not evidence that Earth’s climate is changing, scientists are finding trends in the frequency of extreme weather events around the world. These patterns are observed over many decades, giving scientists increasing confidence about connections to global warming.

suggested procedure

graffiti board activity

1. Introduce the lesson by asking students to share their understanding about the difference between weather and climate. Students take turns contributing to a graffiti board (see resources for a description of this teaching tool). If you do not have access to an online graffiti board the students can create simple “T” charts with “weather” on one side and “climate” on the other side of the T.
2. Students discuss and summarize their collective contributions about the difference between weather and climate.
3. Watch the video, “Climate in a Nutshell: What is Climate?” Using the information from the graffiti board and the video, students identify criteria to decide if a weather event might be connected to climate change. For example, they might identify such criteria as time/duration, frequency, trends, patterns, and changes from normal conditions.
4. Conclude this portion of the lesson with students completing the student pages: CLIMATE VS. WEATHER INTRODUCTORY AND CONCLUDING QUESTIONS and/or the “CONNECT THE MINDS” LEARNING EXPERIENCE ORGANIZER (LEO).

climate and weather analogies

5. Explain that communicating science to the public is one aspect of a scientist’s job and some scientists create analogies to help people understand science. Climate scientists sometimes use examples from everyday life to help illuminate climate concepts to the public, like the difference between weather and climate. Have a group of students or the entire class watch the video *Science Made Simple: Take the Dog for a Walk*, as an example of a climate analogy.
6. (optional) Ask the students to graph the dog and the owner in two other situations. Situation 1: The owner is walking on a steady course at the same level for 15 blocks while the dog wanders all over. Situation 2: The owner is walking on a gradual uphill street for 10 blocks and then for the last 5 blocks on steep hill to climb. The dog continues to walk all over. Discuss the value of graphs to help model situations, describe linear relationships and exponential functions.
7. In small groups have students brainstorm ideas for an analogy to explain the difference between climate and weather, weaving in the importance of climate change. Groups prepare a 1-minute presentation on the analogy they develop. Poster paper can be used for students to visualize ideas.
8. Pass out copies of the rubric for this activity for students to refer to as they develop their analogies.

9. They may complete the activity by answering the concluding discussion questions on the student page: CLIMATE VS. WEATHER INTRODUCTORY AND CONCLUDING QUESTIONS and/or the use another box on the "CONNECT THE MINDS" LEARNING EXPERIENCE ORGANIZER (LEO).

wrap-up and discussion

10. Once groups have completed their analogies, each group presents to the class.
11. Peer-to-peer feedback on the analogies each group developed using the rubric provided in the Assessment.

Discuss each group's response to the concluding question: Reflect on the quote at the beginning of Lesson 1.2:

"If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events."

12. Discuss why understanding the difference between climate and weather and its relationship to risk is important.

EXTENSION: For teachers who wanted to continue looking into the social and environmental implications of confusing weather and climate, the BBC article "[Scientists Must End the Confusion](#)" provides an interesting reading to for further discussion.

assessment

Weather and Climate Analogy Rubric

4	Concisely and accurately states the analogy relationship between 2 or more characteristics that distinguishes weather and climate. The explanation shows an understanding of the most important differences expressed in the analogy.
3	Concisely and accurately states the analogy relationship for at least one characteristic that distinguishes weather and climate. The explanation shows an understanding of important differences expressed in the analogy.
2	Generally expresses the difference better weather and climate in the analogy, with minor misconceptions.
1	Identifies differences between weather and climate that are not very important or has some key misconceptions about the relationship.

feedback

The authors of Hot value your thoughts and feedback on this curriculum. Please feel free to send us any suggestions or share anything your students found particularly interesting or engaging.

Comments can be sent to cah40@columbia.edu

STUDENT PAGES: LESSON 1.4 CLIMATE VS. WEATHER

INTRO & CONCLUSION QUESTIONS

Name: _____

Date: _____

Introductory Questions

1. What is the difference between weather and climate?
2. Which is weather and which is climate? Babe Ruth hits the ball and gets a homerun in a game. Over the course his 22-year career, he came to bat 8399 times and got 2873 hits. His career batting average was .342.
3. How might people confuse weather and climate? Provide examples.

Concluding Questions

4. Why does understanding the difference between climate and weather matter?
5. Reflect on the following statement.

"If climate is the sum of our expectations, climate change is an alterations in those expectations...Although climate change cannot be seen in any one particular storm, heat wave or cold snap, it is found within the changing frequency of such events." *Climate Change: Picturing the Science*

STUDENT PAGES: LESSON 1.4 CLIMATE VS. WEATHER




CONNECT THE MINDS LEO




Name: _____

Date: _____

Use this Learning Experience Organizer (LEO) to make connections between things you've read, heard, seen or experienced inside and outside of class.

Make sure you are specific about the ideas you are going to connect. For example, if the idea you are using comes from a book or film you want to copy the **EXACT** passage from the book in one of the upper boxes. Use the bottom rectangle of each box to explain **WHY** you made a unique connection between two ideas. This will prepare you for metaphorical thinking!

1. 	
<p>Reason for</p>  <p>Connection</p>	

2. 	
<p>Rationale for</p>  <p>Connection</p>	

This Learning Experience Organizer (LEO) for Differentiated Literacy is ©2013 Mindblue – available as a downloadable quiz at the Making Curriculum Pop Social Network

Does the world's rising temperature affect me?

COMMUNICATE

I.5 CLIMATE CHANGE NARRATIVES TIME: 120-150 minutes or 2-3 class periods + writing time /homework

Photo Credit: Need to Find

"An informed public, therefore, is essential for the world to find effective solutions for one of the most harrowing and complex problems facing humanity. Yet, with the challenge so complex, so encompassing, and with so much inherent uncertainty, finding a path to public understanding and responsible solution action is vast in its own right."

- Climate Change: Picturing the Science

overview

Students develop a persuasive, evidence-based climate change news narrative to educate their peers.

objectives

The student will be able to...

- make connections between different lines of evidence to determine the important factors in climate change
- incorporate time and spatial scale into scientific arguments
- write and present a science-based news story as a blog to explain and educate a general audience about global climate change

Prerequisite

Hot Lessons 1.2 and 1.3

key vocabulary

Consequence: An effect or result that follows a certain set of conditions.

Hypothesis: A proposed explanation for something based on some preliminary evidence.

Scientific consensus: The collective judgment of scientists in a particular field.

Theory: An accepted explanation of how something works based on repeated tests.

differentiation guide

This lesson differentiates content, process, product based on student readiness, interests and learning profile. To be completed...

subjects

English Language Arts, Earth and Environmental Science, Social Studies

standards**NGES ESS3.D Global Climate Change**

Human activities affect global warming

CCSS ELA Literacy:

Engage in collaborative discussions and claims and findings (SL.1-3, 4)

Present claims and findings; use multi-media and visuals (SL.4-5)

resources / materials

BBC Climate Challenge Video (2:01 minutes) at

<http://goo.gl/SsiAI>

Collaborative Mind Mapping Site - www.mindmeister.com.

For samples of climate news reporting at Climate Desk (www.climatedesk.org) that includes print and video stories from *The Atlantic*, The Center for Investigative Reporting, *Grist*, *The Guardian*, *Mother Jones*, PBS's *Need to Know*, *Slate* and *Wired*).

Bloomberg News, <http://goo.gl/GVtQ7F>.

Discovery News' global warming video playlist (<http://goo.gl/wcf4VW>).

background

Science is the human endeavor to explain the world around us. By nature, scientists are questioners. They question how things work, why something is happening and one another's work. When scientists study a problem, they develop a hypothesis, test it by running an experiment, and analyze the data produced from the experiments to decide whether it supports or undermines a hypothesis.

A scientific hypothesis that evolves into an accepted theory has been tested many times by many scientists whose results re-confirm the hypothesis. In other words, a scientific consensus is achieved, and accompanying it is a body of knowledge to explain the theory. Likewise, hypotheses are regularly rejected when scientists consistently produce research results that do not support their ideas. Scientists are bound by a professional code that requires "full disclosure" so they explain the uncertainty in their research results. One way to look at what scientists do is to compare their practice to lawyers. Lawyers have an argument they are trying to support and then look for all the evidence to support it and make the best case. Scientists look at and analyze the evidence and then develop scientific arguments based on the story found in the evidence. Moreover, scientists, unlike lawyers, reveal what is uncertain in their arguments.

Climate scientist have a big job to try to communicate their research in ways that help non-scientists understand the world and be able to use the knowledge to inform decisions that affect us and the planet. The complexity of the real world climate makes doing this difficult because there is an inevitable uncertainty in research results. A second challenge is science results are constantly being interpreted and re-communicated by others who have various interests - political, economic and ethical.

So, we - the public, media and policy-makers - have a big job too if we are going to use the best available information from science to make informed decisions about climate change. That is to try to appreciate how science knowledge develops and interpret more with the objectivity of a scientist rather than the subjectivity of an advocate.

In this lesson students assume the roles of TV science journalists to report on the story of climate to the general public. By evaluating and piecing multiple streams of scientific evidence, students demonstrate what they are learning by interpreting climate change science while they develop a wide range of literacy skills. One of the big ideas we hope they leave Unit 1 appreciating is the real experiment that climate scientists are studying is not happening in a lab or in a computer simulation, it is happening all over the planet we live on. We humans started this experiment 150+ years when we began using fossil fuels to support most of our energy. Since Earth is the only planet we know about that supports life, unlike most science experiments, this is one is not reproducible and we have only one chance to get it "right."

suggested procedure**assessing quality climate change reporting**

1. Show the video *Climate Challenge* (<http://goo.gl/SsiAI>) and ask students to critique it. What did they think was effective or ineffective about this video? Ask students to brainstorm a list of characteristics that makes communication about scientific research effective. Share these traits on the board or digitally brainstorm as a class using an online app like www.mindmeister.com.
2. Have students individually select a print or video story about climate change by searching Climate Desk's* (www.climatedesk.org) headlines and archive, Bloomberg News, <http://goo.gl/GVtQ7F> or Discovery News' global warming video playlist (<http://goo.gl/wcf4W>). **NOTE:** Teachers may also print out or copy 5-stories from Climate Desk and have students read different stories in groups of their choosing.

*Climate Desk collects climate news from print and video outlets including *The Atlantic*, The Center for Investigative Reporting, *Grist*, *The Guardian*, *Mother Jones*, PBS's *Need to Know*, *Slate* and *Wired*. Students can search the archive for topics or regions that are of special interest to them by scrolling to the bottom of the page.

3. After students read their articles, have them use the student page the TEXT REFLECTION GUIDE and critique how the climate change narrative was developed.

Pre-writing the climate change narrative

4. Divide students into teams of 4. Explain that they are going to be TV (or web) journalists who must create a compelling, evidence-based 2-minute news story about the climate change science explored in this and previous lessons. The story should inform a general audience of their peers using at least two graphs/images from Lesson 1.3.

Does the world's rising temperature affect me?

Students should develop a script for the news report. They can videotape or present a “live news report” in front of the class. Stories should creatively use audio and visual elements. For live reports, students can create Power Point presentations to act as their “news screen” to the right of the anchor.

5. Teams can use the student page DEVELOPING THE SCIENCE NEWS STORY to organize thinking and prepare a story outline. **NOTE:** For tips on how to write effective TV news scripts see “News Writing Tips for TV News” (<http://goo.gl/QjegR>) and this BBC News lesson plan with writing templates, “Script-writing tips and real examples”(<http://bbc.in/16snBvP>)
6. Decide if you will be giving students in class or at-home time to complete their group news report.

presenting the story

7. Each team is provided with 2-minutes to present their climate change narrative in class.
8. Following each presentation, students are given a short period of time to ask questions. The teacher and/or class may use the attached CLIMATE CHANGE NARRATIVE RUBRIC to assess each presentation. Be sure to collect the rubrics following each presentation and share the student feedback appropriately.

wrap-up and discussion

9. Ask students to reflect generally on all the presentations with the student page PLUS / DELTA CHART. What were some of the more effective strategies students used? What techniques might have improved the climate change narratives?
10. Wrap up the discussion by asking students to reflect on the quote at the beginning of the lesson.

assessment

Students use the CLIMATE CHANGE NARRATIVE RUBRIC on the student pages for peer review of each team's presentation. Copies of the rubric should be made for all students to review their peers' presentations.

Teachers can also use student feedback to assess student's ability to critically apply their knowledge of climate change science.

feedback

The authors of Hot value your thoughts and feedback on this curriculum. Please feel free to send us any suggestions or share anything your students found particularly interesting or engaging.

Comments can be sent to cah40@columbia.edu

STUDENT PAGE LESSON 1.5 CLIMATE CHANGE NARRATIVE

Exploring Quality Science News Stories

Name: _____

Date: _____

Please use prompts below to respond to the text you just read/saw/heard/viewed. Use the back of this sheet if you need additional space.

Thesis, purpose, theme, or main idea of the text:

List three relevant facts, ideas or events the author used to develop the main idea:

-
-
-

Vocabulary that needs defining:

Points of interest in the text:

Areas of improvement in the text:

Connections you made from reading/viewing the text (if you would like, you may draw a mind-map below):

Does the author offer a solution to his/her stated problem or do they leave you with a question they want you to think about? Explain your thoughts below.

STUDENT PAGE LESSON 1.5 CLIMATE CHANGE NARRATIVE

Developing your Science News Story

Name: _____

Date: _____

DIRECTIONS

Use this graphic organizer to develop a 2-minute story on climate change for your peers. You may not use every prompt below, but you will likely use most of them. This sheet can also help your group assign roles. Possible roles include:

script writer: craft script from sample scripts found at BBC News @ <http://goo.gl/QjegR>.

fact checker: this person makes sure the claims made in the segment are supported by scientific evidence.

news anchor: narrates the story.

actor/s: someone might play a scientist that is being interviewed or people effected by climate change.

camera person / editor: if you're doing video someone will need to shoot and edit your segment.

Producer: if doing a live performance in class this person might prepare your Power Point™, video clips and audio.

Questions	Key Points for Narrative	Supporting Audio or Visual	Team Member & Role
What is the climate change research and/or challenge you want to share with your audience? <i>This is similar to your thesis statement.</i>			
What do you think are the most important lines of climate change evidence to support your story? <i>This is a series of claims supported by evidence.</i>	<ul style="list-style-type: none"> • • • 		
Where is this climate change story happening? <i>This is the spatial scale or area for evidence.</i>			
How do we know the evidence being presented e.g. how was it obtained?			
How long have humans been the dominant driver of climate change? <i>This clarifies timescale or relevant time period.</i>			
Who and what is impacted by human-caused climate change and how ?			
Why does human-caused climate change matter?			
What fundamental actions do we to take to address the problem and what might be the solutions?			

<p>STUDENT PAGE LESSON 1.5 CLIMATE CHANGE NARRATIVE</p> <p style="text-align: center;">Climate Narrative Rubric</p>	<p>Name: _____</p> <p>Date: _____</p>
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News segment producers: _____

Title of news segment: _____

DIRECTIONS:

This rubric can be used by the teacher or peers to assess the quality of students' climate narratives. Be sure to write the names of the students on the team you are reviewing in the space provided above and your name (as the reviewer). Be sure the class / teacher determines the value of each dimension of the rubric before you assess.

Assessment Dimension	Point Value	Your Score
Script <i>Was the news segment built from a script?</i> <i>Did the script have a clear beginning, middle and end?</i> <i>Did the script make room for visuals, interviews and additional footage aka B-roll?</i>		
Titles <i>Was there a clear and concise headline?</i> <i>Was a main idea/thesis clearly articulated?</i> <i>Were events and speakers titled as they appeared in the story?</i>		
Claims and evidence <i>Were claims relevant to their main idea?</i> <i>Were claims clear understandable for peers?</i> <i>Were claims supported by diverse sources?</i> <i>Were lines of evidence coming from credible, properly cited sources?</i> <i>Were lines of evidence clearly sourced / credited?</i>		
Audio, Visual / Theatrical (for in class or video taped stories) <i>Did the team utilize visuals to enhance their story?</i> <i>Did the team use audio effectively (music, sound effects, and speaking)</i> <i>When possible, did the team utilize sets and costumes?</i>		
Mechanics Did the team use a variety of sentences? Did the team avoid run-ons and present understandable thoughts? Were spelling, grammar and punctuation used appropriately?		
Overall Creativity and Clarity Did the team tell their narrative in a unique way? Did the team capture the audience's attention? Did the team present a science story that was clear and understandable?		
TOTALS	100 points	

COMMENTS:

STUDENT PAGE LESSON 1.5 CLIMATE CHANGE NARRATIVE

+ / Δ Narrative Reflection

Name: _____

Date: _____

DIRECTIONS:

This + / Δ graphic organizer can be used to reflect on the general quality of the presentations. Don't worry about a specific presentation. Instead focus on general trends. What did you think made a climate change narrative effective? What do you think was a stumbling block for teams trying to explain complicated science in two-minutes? Share your reflections in the space below.

+ THINGS I LIKED ABOUT THE PRESENTATIONS

Δ WHAT WOULD I CHANGE ABOUT THE PRESENTATIONS?